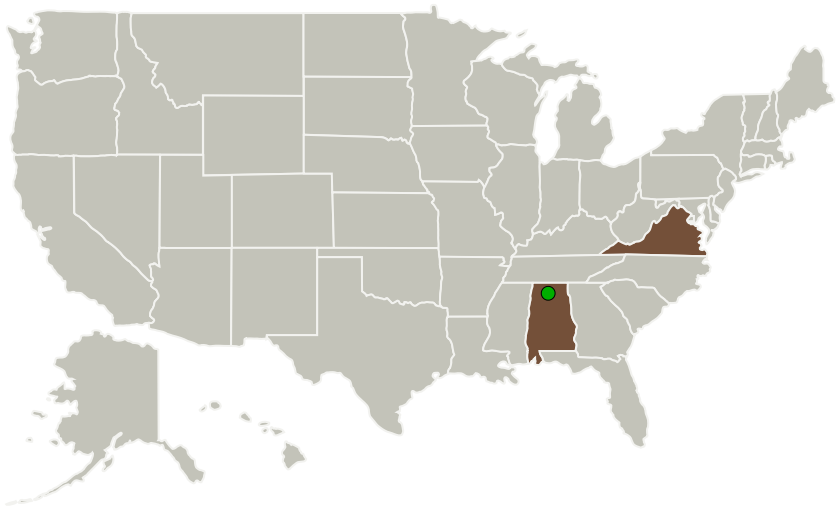
Radiation Hardened Nanobridge based Non-volatile Memory for Space Applications, Phase I

Completed Technology Project (2012 - 2012)

Project Introduction

This NASA Phase I SBIR program would develop and demonstrate radiation hardened nanobridge based non-volatile memory (NVM) for space applications. Specifically, we would combine advances in the resistive memory materials, including solid electrolytes, metal oxides, and metal oxide composites, with atomic layer deposition (ALD) and interference lithography patterning (ILP) techniques, to realize the radiation hardened NVM devices and arrays with high reliability. NanoSonic has demonstrated a nanobridge based resistive memory with on-off ratios of 106, device power consumption of 10-5 Watts and switching speeds of 100ns. We have also demonstrated ILP techniques for the patterning of nanostructured 2D arrays and 3D structures with spatial resolution on the order of tens of nm. During the program, we will first investigate the responsible mechanisms for radiation hardened nanobridge based resistive memories. Based on this study, the candidate metal electrode and dielectric materials will be evaluated and selected for optimal performance for radiation harden application. NanoSonic will fabricated arrayed devices with ultradense crossbar latches structure, using radiation hardened metal oxides such as TiO2, SiO2, Ta2O5, especially composite TaSiO to validate our design rules for radiation hardened memories. The atomic layer deposition (ALD), e-beam evaporation, sputtering and will be used to achieve the targeted device performance. During Phase I, memory device parameters namely on–off ratio, on-state current, switching time, retention time, cycling endurance, power consumption and rectification will be investigated using extensive facilities available in NanoSonic and Virginia Tech. NanoSonic will conduct pre, post and in situ radiation characterization of such devices at Colorado State University and Texas A&M University.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Nanosonic, Inc.	Lead Organization	Industry	Pembroke, Virginia
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Virginia

Project Transitions

February 2012: Project Start

August 2012: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138439)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Nanosonic, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Yuhong Kang

Co-Investigator:

Yuhong Kang

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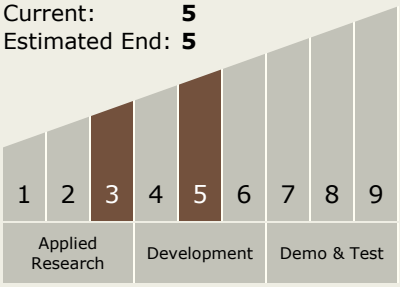
Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX10 Autonomous Systems
  - TX10.1 Situational and Self Awareness
    - TX10.1.4 Hazard Assessment

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System